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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/796,695
Filing Date: March 08, 2004
Appellant(s): YOUNG, WAYNE D.

____
Michael L. Drapkin

For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed February 17, 2009 appealing from the Office action mailed May 8, 2007.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is incorrect. A correct statement of the status of the claims is as follows:

This appeal involves claims 1-3 and 6-20.

Claims 4 and 5 have been canceled.

(4) Status of Amendments After Final

No amendment after final has been filed.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is substantially correct. The changes are as follows: Claims 1-3, 10-15, 17, 18, and 20 are actually rejected under 35 USC 102(e), not 35 USC 102(b) as stated by appellant.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

2004/0100646	Quintana	5-2004

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1-3, 10-15, 17, 18, and 20 are rejected under 35 U.S.C. 102(e) as being anticipated by Quintana.

As to claim 1, Quintana discloses a method of dithering an image, the method comprising the acts of:

receiving a target color at a high color resolution for a current one of a plurality of pixels of the image, the target color being intermediate between a first color and a second color at a low color resolution (fig. 3, p. 2, section 0025; the example of a 186 color component value is given in a 0 or 255 binary system);

tracking an accumulated error across the plurality of pixels up to and including the current pixel (fig. 3; p. 2, section 0025; an “accumulated error” is a running total of differences between intensity values and actual output values; the current pixel is also included at fig. 3, element 312);

selecting one of the first color and the second color as a final pixel color, wherein the first color is selected in the event that the accumulated error is less than a threshold, wherein the second color is selected in the event that the accumulated error exceeds the threshold (fig. 3, elements 310, 106; an “on” pixel is output when the error exceeds a certain value, otherwise the pixel is not turned on).

providing an updated accumulated error to a next one of the plurality of pixels (fig. 3, element 114; after all color component values for a single pixel have been decided, the system moves on to the next pixel and repeats the process);

and outputting the selected final pixel color for display on a display device (fig. 3, element 106; p. 2, section 0025; a final pixel color value of 0 or 255 is selected for output on a printer, which reads on a display device; this final color value that appears on a piece of printed paper corresponds to white if 0 and cyan, magenta, yellow, or black if 255).

While the disclosure of Quintana does not specifically disclose that the accumulated error is reduced below the threshold in the event that the second color is selected, simple calculations show that this is inherent to the invention. Quintana subtracts the value for output pixel from the accumulated error to calculate a new accumulated error in fig. 3, element 314. Assume the first color value is zero, and the second color is 255, as in the example of p. 2, section 0025. Now, looking at the embodiments disclosed in p. 3, section 0031, the maximum error value is 256. The corresponding threshold value (i.e. the value which all values must be LESS than) is 257.

In the absolute worst case scenario, the accumulated error after step 308 of fig. 3 would be:

(max. error value) + (max. possible current color component value) =

255 + 256 = 511

In step 106, an output pixel of value 255 would be output. Then in step 314, the accumulated value would be adjusted to:

(accumulated error) – (output value) = 511 – 255 = 256

Thus, the accumulated error would be 256, reduced below the threshold value of 257. If the second color is selected, 255 is always subtracted from the accumulated error meaning that the error will always be reduced below the threshold in the event that the second color is selected.

As to claim 2, Quintana discloses a method wherein the act of tracking the accumulated error includes the acts of:

determining a current error based on a difference between the first color and the target color (fig. 3, element 312; the “current error” is the absolute difference);

and adding the current error to the accumulated error (fig. 3, element 312; the error adjustment factor is a second variable which tracks error, and therefore this reads on an accumulated error as well).

As to claim 3, Quintana discloses a method further comprising the act of reducing the accumulated error by an amount corresponding to the threshold in the event that the second color is selected (see rejection to claim 1, the value subtracted and the threshold are substantially corresponding, only 1-2 values different).

As to claim 10, Quintana discloses a method wherein the threshold corresponds to a difference between respective high resolution representations of the first color and the second color (see rejection to claim 1; the threshold and difference between colors are substantially corresponding, only 1-2 values different).

As to claim 11, Quintana discloses a method wherein the target color is one of a plurality of independent color components for the pixel (fig. 3, elements 304, 306; the target color corresponds to one of a plurality of independent color components).

As to claim 12, Quintana discloses a device for dithering an image, the device comprising:

an accumulator module configured to track an accumulated error across a plurality of pixels of the image (fig. 3; p. 2, section 0025; an "accumulated error" is a running total of differences between intensity values and actual output values; the current pixel is also included at fig. 3, element 312);

a conversion module configured to receive a high resolution color signal for a current pixel of the image and to generate a corresponding low resolution color signal (fig. 3, p. 2, section 0025; the example of a 186 color component value is given in a 0 or 255 binary system);

and an adjustment module configured to modify the low resolution color signal from a first color to a second color for the current pixel in the event that the accumulated error exceeds a threshold (fig. 3, elements 310, 106; an "on" pixel is output when the error exceeds a certain value, otherwise the pixel is not turned on; the "current" color is changed from a value that would just be rounded to an error-adjusted value reading on a change from "first color" to "second color");

and an output module configured to output the low resolution color signal for the current pixel for display on a display device (fig. 3, element 106; p. 2, section 0025; a final pixel color value of 0 or 255 is selected for output on a printer, which reads on a

display device; this final color value that appears on a piece of printed paper corresponds to white if 0 and cyan, magenta, yellow, or black if 255), wherein after processing the current pixel, the accumulated error is provided to a next one of the plurality of pixels (fig. 3, element 114; after all color component values for a single pixel have been decided, the system moves on to the next pixel and repeats the process).

As to claim 13, Quintana discloses a device wherein the accumulator module includes:

a current error circuit configured to extract a current error from the high resolution color signal for the current pixel (fig. 3, element 312; the “current error” is the absolute difference);

and a first adder circuit configured to add the current error to the accumulated error and to provide an updated accumulated error to the adjustment module (fig. 3, element 312; the error adjustment factor is a second variable which tracks error, and therefore this reads on an accumulated error as well).

As to claim 14, Quintana discloses a device wherein the adjustment module includes:

a comparator circuit configured to compare the updated accumulated error to a threshold, thereby generating a dither control signal (fig. 3, element 310; an accumulated error is compared with a “maximum allowed error value”);

and a second adder circuit configured to receive the low resolution color signal from the conversion module and to adjust the received low resolution color signal based on the dither control signal, thereby generating a final color signal (fig. 3, element 106;

an “on” pixel is output when the error exceeds a certain value, adjusting the low resolution color signal).

As to claim 15, Quintana discloses a device wherein the comparator circuit is further configured to provide the dither control signal as a feedback signal to the accumulator module, and wherein the accumulator module is further configured to reduce the accumulated error based on the dither control signal (fig. 3, element 314; the accumulated value is adjusted based on a feed from the current output pixel).

As to claim 17, Quintana discloses a device wherein the adjustment circuit includes an adder circuit configured to add the accumulated error to the high resolution color signal, thereby generating an intermediate color signal (fig. 3, element 308).

As to claim 18, Quintana discloses a device wherein the conversion circuit includes a truncator circuit configured to reduce the intermediate color signal to a low resolution color signal (fig. 3, element 310; the color is reduced to zero if it does meet a threshold).

As to claim 20, Quintana discloses a graphics processing unit comprising:

a geometry pipeline unit configured to generate pixel data for an image (fig. 4, 5; image-forming and output pixel data mechanisms are disclosed);

and a scanout module configured to provide the pixel data to a display device (fig. 3, element 106; a pixel is output), wherein the scanout module includes a dithering unit, the dithering unit comprising:

an accumulator module configured to track an accumulated error across a plurality of pixels of the image (fig. 3; p. 2, section 0025; an “accumulated error” is a

running total of differences between intensity values and actual output values; the current pixel is also included at fig. 3, element 312);

a conversion module configured to receive a high resolution color signal for a current pixel of the image and to generate a corresponding low resolution color signal (fig. 3, p. 2, section 0025; the example of a 186 color component value is given in a 0 or 255 binary system);

an adjustment module configured to modify the low resolution color signal from a first color to a second color for the current pixel in the event that the accumulated error exceeds a threshold (fig. 3, elements 310, 106; an “on” pixel is output when the error exceeds a certain value, otherwise the pixel is not turned on; the “current” color is changed from a value that would just be rounded to an error-adjusted value reading on a change from “first color” to “second color”);

and an output module configured to output the low resolution color signal for the current pixel for display on a display device (fig. 3, element 106; p. 2, section 0025; a final pixel color value of 0 or 255 is selected for output on a printer, which reads on a display device; this final color value that appears on a piece of printed paper corresponds to white if 0 and cyan, magenta, yellow, or black if 255).

Claims 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Quintana in view of Keithley (U.S. Patent Number 6,028,677).

As to claim 6, Quintana does not expressly disclose a method wherein the plurality of pixels corresponds to a scan line of a display device. Keithley, however, teaches an error diffusion method that does correspond to a number of pixels in a scan

line (col. 5, lines 11-15). The motivation for doing error diffusion by scan line is to minimize memory requirements for a dither operation (col. 2, lines 15-30). It would have been obvious to one skilled in the art to modify Quintana to perform error diffusion by scan line in order to minimize memory requirements as taught by Keithley.

As to claim 7, Keithley discloses a method further comprising the act of initializing a threshold value at a beginning of the scan line (col. 3, lines 29-57). While this does not precisely correspond to an “accumulated error”, they are functionally equivalent. Changes in either one of the values simply make the result of a comparison less dependent on a previous scan line.

Claims 8-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Quintana in view of Keithley and further in view of Li (U.S. Patent 6,563,957).

As to claim 8, Keithley does not disclose an accumulated error initialized to a

value that depends at least in part on a line number of the scan line, instead selecting values at random. Li, however, discloses changing an error diffusion filter based on an even or odd line number (col. 19, lines 26-34). Much like the Keithley reference, Li is not changing an actual “error accumulation value”, but is teaching the advantages of changing qualities related to error diffusion by line. The motivation is to improve texture quality while also not increasing computational complexity (col. 19, lines 26-34). It would have been obvious to one skilled in the art to modify Quintana in view of Keithley to make changes in values related to error diffusion based on a line number in order to improve texture quality efficiently as taught by Li.

As to claim 9, Keithley discloses a method wherein the accumulated error is initialized to a value that is different for successive frames (col. 3, lines 29-57; because each value is initialized randomly, a different value for successive frames is extremely likely to be inherent to the invention).

Claims 16 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Quintana.

As to claim 16, a device wherein the accumulator module includes some sort of storage configured to store the accumulated error is inherent to the invention of Quintana. The accumulated error must be saved somewhere to be used in later steps. Official notice has been taken of the fact that using a register as a storage is well-known in the art (see MPEP 2144.03). It would have been obvious to one skilled in the art to modify Quintana to use a register in order to efficiently store a value for later use.

As to claim 19, Quintana discloses a device wherein the truncator circuit is further configured to reduce the intermediate color signal by removing a number of least significant bits (fig. 3, p. 2, section 0025; changing 186 to a value of 0 or 255 inherently means that a number of least significant bits will become zeros) and to store the removed least significant bits as a new accumulated error (fig. 3, element 312; the "current error" or absolute difference would then become part of an accumulated error). Quintana does not expressly disclose a register. Official notice has been taken of the fact that using a register as storage is well-known in the art (see MPEP 2144.03). It would have been obvious to one skilled in the art to modify Quintana to use a register in order to efficiently store a value for later use.

(10) Response to Argument

A. Appellant argues that Quintana does not select a "final pixel color".

Appellant notes that the Quintana reference discloses determining whether or not to output an output pixel, arguing that this is not the same as determining a final pixel color. Examiner has noted in past Office Actions that the Quintana reference is related to printing, and therefore selects between printing a color of ink on a page, or simply leaving the page as-is. The first color here is the color of ink, e.g. cyan, magenta, yellow, or black, while the second color is the color already existing on the page. This second color is usually white, but obviously depends on the color of paper used and the colors that have already been applied to the page. The examiner's previous assertion that not printing a dot on a paper produces a final pixel color equivalent to white is factually correct if one assumes the paper was white to begin with.

Appellant further notes that a determination to output or not output a pixel for a color component is then followed by the same determination for the next darkest color component. Appellant argues that, because this is a multi-step process for each location on a printed page, each color component determination does not actually determine a "final pixel color". Instead, appellant argues, the determination of whether to output a pixel for a color component is just a single step in this process. Examiner notes that this is a very narrow reading of the term "final pixel color". Appellant appears to want to read the term "final pixel color" to mean the total color printed in one location on a piece of a paper, or seen in one location on a screen. However, this ignores the fact that the dot printed for *each color component* is considered a pixel in printing

applications, and therefore its color would be a "final pixel color". The Quintana reference supports this, stating on page 4, section 0037, that “the output pixel mechanism 504 determines whether, for each color component of each image pixel, an output pixel should be output”. Note that Quintana does not refer to each color component determination as a step in a multi-step process to determine pixel color. Rather, Quintana explicitly states that each component determination determines whether a *pixel* should be output. As noted above, the pixel color being output results in one color being displayed, while the pixel not being output results in a different color being displayed. Therefore, the Quintana reference selects a “final pixel color” for each color component. Appellant argues that each color component determination is a part of a process to determine a final pixel color, but the Quintana reference discloses that each color component determination *itself determines a final pixel color*.

Appellant argues that a decision not to output a pixel does not cause "white" to be the final pixel color, instead triggering other color determinations to determine a "final pixel color". Examiner admits that previous arguments made by examiner directed to “white" being the final pixel color may have been overly simplistic, as non-white paper, or paper already inked, would not have a final pixel color of white as an option. Perhaps a better way to state this argument is that the Quintana reference discloses a decision to output a pixel that is either: a) the color of ink being output or b) the previously existing color of the paper. However, the concept remains the same. Regardless of the color of the paper or the color of previous and future inks applied to the paper, the

invention of Quintana is choosing a "final pixel color" each time a color component determination is made.

B. Appellant argues that Quintana does not select between a "first color" and a "second color" for output.

Appellant notes that various passages of Quintana recite a decision whether or not to output a pixel. Appellant argues that outputting a second color differs from a decision to not output a color. The Quintana reference, however, makes it clear that this is not the case. As pointed out in previous arguments, p. 2, section 0025 and p. 3, section 0030 of Quintana clearly state that not outputting a pixel is equivalent to selecting and outputting a pixel value of zero. Quintana at p. 3, section 0030 states "As has been described, it is said that the value of the output pixel when the output pixel was actually output is 255, whereas the value of the output pixel when no output pixel was actually output is zero. This is because the output pixel is binary, having a maximum value, or 255, when the output pixel is output, and having a minimum value, or zero, when it is not output."

Quintana, at p. 1, section 0002, states that "In binary devices, image pixels, having more than two levels of intensity for each color component, are therefore converted to output pixels, having only two levels of intensity for each color component, prior to their output by image-forming devices onto media." Note that in all of these examples, Quintana is clearly stating that not outputting a pixel is associated with an intensity or value. As is known in the art, colors can generally be described using their intensities for each color component. Therefore, by disclosing that even an unprinted

pixel has an intensity value, the Quintana reference is disclosing that it still considers this location to have a color, that color's intensity being zero. More to the point, the Quintana reference discloses choosing between two intensities for a color component output, clearly reading on the claimed “selecting one of the first color and the second color”. For example, if the invention of Quintana were using Cyan in a CMYK color space, a final output color would be selected from (255, 0, 0, 0) and (0, 0, 0, 0), the latter of which would be equivalent to white or whatever other color were already on the page.

Appellant further notes that p. 2, section 0017 of Quintana recites determining spacing of color components with regards to a first output pixel. Appellant argues that a printed pixel triggers spacing of color components, while a non-printed pixel triggers additional color determinations. This does not appear to be relevant to whether Quintana selects between a first color or second color, and examiner has already pointed out, above, why each color component pixel output by Quintana corresponds to a final pixel color. The fact that this is a printer-focused technique does not disqualify the Quintana reference from reading on claims 1-3, 10, 11, 13-15, 17, and 18 of the instant application, as there is nothing specific to an electronic display in these claims.

Appellant further notes that examiner has previously stated that the decision to turn a pixel tuned off, or to not output a pixel, is equivalent to the decision to output a second color. Appellant notes that no citation to this in the Quintana reference is present in the Final Office Action and has assumed examiner was making use of Official Notice to reject claims 1-3, 10, 11, 13-15, 17, and 18. It is noted by examiner that the

rejections of these claims are 102(e) and not 103(a) rejections, and therefore the use of Official Notice would be improper. Rather than using Official Notice, the examiner was actually pointing out why the Quintana reference does teach each and every element of claims 1-3, 10, 11, 13-15, 17, and 18. It is noted that identity of terminology is not required (see MPEP 2131) if the examiner can show that the reference teaches every element of the claim. It is clearly pointed out above how the decision to not output a pixel, as in Quintana, is the same as the decision to output a second color, as in the claims, and so the claims are anticipated by Quintana, with no Official Notice necessary.

C. Appellant argues that the amount an accumulated error is reduced in Quintana does not correspond to the threshold.

Appellant argues that the threshold in Quintana is "half the value of two to the power of the size of the color space", rather than the threshold mentioned in the rejection to claim 1. Examiner agrees that this is one threshold mentioned, in p. 3, section 0028, but not necessarily the only threshold. Quintana also discloses a "maximum allowed error value" in p. 3, section 0031. This section states that the maximum allowed error value is the maximum allowed intensity of a color component, two to the power of the size of the color space, or twice the previous threshold of 128. Examiner notes that while Quintana does not call this "maximum allowed error value" a "threshold", Quintana clearly discloses that if the accumulated error for a component is greater than the "maximum allowed error value", then a pixel is output for that component. In other words, the "maximum allowed error value" is a *de facto* threshold, working just as the "threshold" claimed in claim 1 of the instant application does. The

Quintana reference discloses selecting one color (the ink color) if accumulated error is greater than this value or a second color (the paper color) if the accumulated error is less than this value.

Even assuming, *arguendo*, that the threshold of Quintana must be "half the value of two to the power of the size of the color space", this is still an amount that corresponds to an amount the accumulated error is reduced. Note that claim 3 does not recite that the amount an accumulated error is reduced and a threshold must be the same, or close. Rather, the claim recites that they must be “corresponding”. In the Quintana reference, the value for the output pixel is the value subtracted from the accumulated error, as in fig. 3, step 314. This value is 255, as in p. 3, section 0030 of Quintana. If the threshold is 128, as in p. 3, section 0028, then the threshold is clearly the accumulated error plus one and then divided by two. This “correspondence” works for other sizes of color space as well. If the amount the accumulated error is reduced (equivalent to the highest value of a color component) is 7, the threshold will be 4, as it is half the value of two to the power of the size of the color space (a highest color value of 7 would be a 3-bit color space). No matter what the threshold, the accumulated error reduction will always correspond.

D. Appellant’s argues, in response to grounds of rejections II, II, and IV, that the same arguments appellant argued against ground or rejection I, also apply.

In response, examiner refers appellant to sections A, B, and C of this Examiner’s Answer, in which examiner rebuts those arguments.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

/Aaron M Richer/

Examiner, Art Unit 2628

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